●Electrical Characteristics at Backlight System

The output voltage and current of the inverter to drive CCFLs are likely to be subject to the effect of stray capacitance, because the inverter applies high frequency and high voltage to the lamp which is a high impedance load.

Therefore, it is impossible to directly measure the voltage characteristics of a lamp (lighting start voltage and lamp voltage) in the system. The lamp voltage and lamp current will change, when a probe is connected to high voltage terminals. For a ballast capacitor type, the effect of voltage division with the probe capacitance cannot be neglected.

A typical method to measure the voltage characteristics of a lamp in a system is described below for your reference.

1 Lighting start voltage at System

1-1 Measuring procedure of lighting start voltage

(1) Prepare an inverter for the measurement which can vary the input voltage for variable outputs of the transformers.

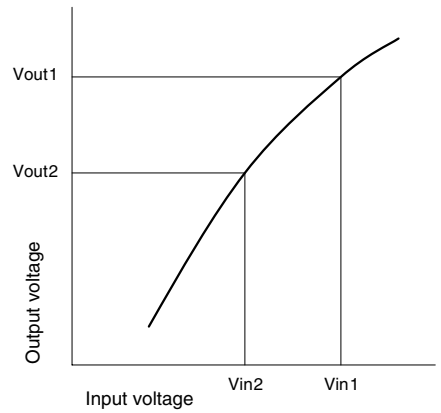
(2) Measure the input/output voltage characteristics of the measuring inverter (Fig. 29) before starting measurement of the lighting start voltage. Measure the transformer output voltage in no load state (output OPEN). Also measure the transformer output voltage, when using a ballast capacitor type.

(3) Connect the measuring inverter to the lamp alone and measure the lighting start voltage Vin1 (inverter input voltage) for the lamp only.

(4) Mount the lamp in the system and measure in the step 3 above the lighting start voltage Vin2 (inverter input voltage) for the system.

(5) Using the values measured in steps (3) and (4), obtain the lighting start voltage for the lamp alone and for the system (Vout1 and Vout2; transformer output voltage) from the inverter input/output voltage characteristics in Fig. 29.

Fig. 29 Inverter Input/Output Voltage Characteristics



Vin 1: Lighting start voltage for lamp only
Vin 2: Lighting start voltage for the system
Vout 1: Lighting start voltage for lamp only
Vout 2: Lighting start voltage for the system

[Cautions]

● When using a ballast capacitor type inverter, the voltage applied to the lamp falls due to the relation between capacitance of the ballast capacitor and the stray capacitance. For a laptop PC or a monitor, reduction in the lighting start voltage due to the effect of adjacent metal frames is expected. In the case of a directly-below type in which the lamp and the conductive area are kept apart from each other, reduction in the lighting start voltage due to the effect of adjacent metal frames is hardly anticipated. Check capacitance of the ballast capacitor and the lighting frequency.

● For the separately-excited ballast capacitorless inverter, output voltage will vary (in relation to lighting frequency) because the resonance frequency of the high voltage circuit is affected by the stray capacitance. Always check the lighting on the actual system. Check the lighting frequency under the actual system condition.

● The lighting start voltage of a CCFL reaches the peak value at low temperature. Check at the low temperature (0°C) under the actual machine condition.

● When measuring inverter input voltages Vin1 and Vin2 (inverter input voltages), apply the voltages Vin1 and Vin2 directly, instead of gradually increasing the inverter input voltage to determine if the lamp lights in a few seconds or not.

● The inverter for the measurement is designed to vary the transformer output by varying the input. Ordinary inverters are controlled in a manner that the transformer output is constant, even if the input is varied.
Contact our Engineering Dept or the inverter supplier for detailed converter specifications.

1-2 Setting Standard for Lighting start voltage for System

Set the standard for the Lighting start voltage for the system as follows:

	Lighting start voltage		Measuring position
	typ	max	
Lamp requirement	VL typ	VL max	Lamp ends
System requirement	Vout 2	Vmax	Transformer output

VL typ: Typical lighting start voltage at ends of the lamp (standard value for the lamp)
VL max: Max. lighting start voltage at ends of the lamp (standard value for the lamp)
Vout 2 : Typical value of transformer output at lighting in the system (standard value for the system)
Vmax : Maximum value of transformer output at lighting in the system (standard value for the system)
Vmax = VLmax - VLtyp + Vout 2

[Cautions]

● A typical lamp should be used when performing the measurement. When ordering from us, specify the standard product for the

measurement.

- The standard for the lighting start voltage for the system should be defined at the inverter transformer output. When using a ballast capacitor type inverter, the value of the ballast capacitor should be stated. The lighting start voltage varies with the value of the ballast capacitor.
- Specify the lighting start frequency of the inverter. Lighting start voltage varies with the starting frequency.

2 Lamp Voltage and Lamp Power at System

2-1 Measuring Method of Lamp Voltage and Lamp Power

(1) In the system state, connect the voltage probe to the lamp at the high voltage side and connect the current probe to the lamp at the low voltage side.

(2) Measure the voltage-current characteristics of the lamp by varying the output of the measuring inverter before starting measurement of lamp voltage and lamp power. Take measurements at the system in thermally saturated state.

(3) Remove the voltage probe from the high voltage side and measure the lamp current for each lamp under the rated system condition (max. dimming). Take measurements when the system has reached thermal saturation. The lamp current is measured on the low voltage side of the lamp.

(4) Determine the lamp voltage corresponding to the current value measured in step (3) using the data from step (2) and find the lamp power for each lamp. The sum of the lamp power values is the total power (WL) of the backlight.

(5) Inverter efficiency (η) is defined by the ratio of total power of the backlight (WL) to input power of the inverter (Win).

$$\text{Inverter efficiency } \eta = (WL/Win) \times 100\ (\%)$$

[Cautions]

- Connect the GND of the case of the system to the GND of the inverter without fail.
- When using two or more lamps, match the phase of the voltage applied to each lamp. In system design, consider the insulation distance between neighboring lamps (lamp leads) when phase inversion is expected in the application.
- In the design of your inverter, consider the leakage current (reactive power) when determining power.
- Specify for us the inverter starting frequency that is determined under the actual machine condition. Lamp voltage varies with the lighting frequency.
- Measurement of the lamp current in the backlight system of the both-ends high voltage type is practically difficult. Sanken recommends, for example, installing a current measuring terminal, etc. at the neutral point of the transformer.